MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF VASSAR COLLEGE

XI. The Effect of Mental Type on the Interference of Motor Habits

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The original purpose of this study was to investigate the influence on the amount of interference exerted by one habit on another, of the simplicity or complexity of the habits concerned. In other words, we wished to find whether two relatively complex habits interfered with each other in a less or a greater degree than two relatively simple habits. For this purpose we made use of the card-sorting habits first investigated by Bergström (this *Journal*, vol. 5, pp. 356 ff.). In the first part of each experiment a pack of cards was used, containing ten cards bearing each of four different nonsense syllables of three letters, thus forty cards in all. Upon a large sheet of paper a square was drawn containing four compartments of about 20 cm. a side, and each of these compartments was marked in large letters with one of the nonsense syllables. The pack of cards was thoroughly shuffled, and the observer was directed to sort the cards on the diagram as rapidly as possible, the time required to complete the sorting being taken with a stop-watch. After an interval of one minute, during which the experimenter shuffled the cards, a second diagram was supplied on which the syllables were differently placed, and the observer was required to sort the cards as fast as possible in this new arrangement. If the time of the second sorting was longer than that of the first, the delay was supposed to be in part at least due to the interference of the earlier acquired habit with the acquisition of the later one, in accordance with Bergström's view. The second part of each experiment consisted in repeating this procedure with a pack containing ten cards carrying each of six different syllables, sixty cards in all. In the third part, a pack with eight different syllables, ten cards for each, eighty cards in all, was used, and in the fourth part a pack with twelve different syllables, a hundred and twenty cards in all. Thus in the four parts of the experiment habits of four different degrees of complexity were involved. As the time of sorting the larger packs was of course longer than that required to sort the smaller ones, the amount of interference was stated in terms of the ratio to the time of the first sorting, of the amount of delay in the second sorting. Thus, if t represents the time of the first sorting, and t′ that of the second sorting, t′-t = the delay in the second sorting, presumably due to interference, and $\frac{t'-t}{t}$ represents the ratio of the amount of interference to the time required by the first sorting. It was this ratio that we recorded. We wished to find whether this value would increase, diminish, or remain unaffected when the complexity of the habits was increased. Three observers took part in the work, M and W, the writers, and H, a woman student in her second semester of laboratory work. Ten complete experiments of four parts each (eight sortings in an experiment) were made and averaged for each observer. The results were as follows:

Observer	Average values of $\frac{t'.t}{t}$			
	Four pack	Six pack	Eight pack	Twelve pack
M	.20	.29	.24	.17
W	.23	.16	.15	.14
H	.18	.21	.23	.13

It will be seen that the only point in which the three observers agree is that they all show the least amount of interference in the case of the most complex habit. Although in the case of all four grades of complexity, the habits were allowed an equal chance to be learned, since a given card was always placed in a given position ten times during the sorting; although each movement in each set of sorting movements was thus performed exactly the same number of times, and had the same chance to impress itself on the nervous system, the most complex habit was not so well learned as the simpler ones, indicating that the difficulty of acquiring a habit increases not in direct proportion to its complexity, but more rapidly. It is further evident that observers M and H found the simplest habits interfering less with each other than those of moderate complexity. This, it was gathered from their introspections, was due to the fact that in the very simple four-position sorting, the second diagram was learned on its own account so quickly that the disturbing effect of the first diagram wore off after a few seconds. These same introspections revealed an important cause for the individual differences in our results. M is of a decidedly visual type of mind. In sorting the cards, she rapidly formed a visual image of the diagram and guided herself almost entirely by this. She did not need, after the first seconds of a sorting process, actually to look at the marks on the compartments, because she had a picture of the whole chart in her mind. W, on the other hand, is decidedly below the average in visualizing power. She learned the diagrams almost wholly in motor terms, and at the end of a sorting was quite unable to recall the position of more than two or three syllables on the more complex diagrams, having scarcely any visual image of the diagram. M, on the contrary, could reproduce all the diagrams perfectly from her mental pictures of them. H seemed to occupy a middle position as to type; her visual images were not so marked as M's, nor by any means so defective as W's. It will be seen from the results that the degree of interference in W's case diminished steadily as the complexity of the habits increased. W did not find that the simplest diagram was less favorable to interference than those of moderate complexity. While for M and H, learning the diagrams by a visual method, the second diagram in the four-position sorting was learned so quickly that it soon effaced the visual memory of the first diagram, for W, in whose case the memory of the first position diagram was almost wholly motor, this memory persisted much longer and seriously interfered with the formation of the new habit. We have here a suggestion of the fact that visual images are acquired and effaced more rapidly than motor habits. While M and H both used visual images in their learning, these images were naturally more effective in the case of the simplest chart, where they were formed almost at the outset of the sorting. Hence the images functioned to reduce the interference effect in the case of this diagram by facilitating the learning of the new position; while in the case of W we have the law that simpler habits are acquired better than complexer ones even where each movement in all the habits is repeated an equal number of times, holding without exception.

This difference of mental type in our three observers suggested two supplementary sets of experiments. It occurred to us, first, that an observer whose card-sorting was guided by a mental picture of the

diagram would be much less disturbed when the diagram was turned about through an angle of ninety degrees than would an observer whose learning was done largely in motor terms, for the former could without much difficulty turn her mental picture of the chart about to correspond with its new position, while the latter would be bewildered by the fact that all the movements involved in sorting would be entirely changed by the rotation. Accordingly this point was investigated in the following way. The four-syllable pack was first sorted on one of the diagrams used in the preceding tests, and then after the usual one-minute interval the diagram was turned through ninety degrees and the observer was required to repeat the sorting process. Five such experiments were made by each of the two observers M and W. The average delay involved in making the second sorting, in the rotated position, with observer M was —2.6 seconds; that is, M made the second sorting more rapidly than the first. She was little, if at all, disturbed by the rotation, and reported that she visualized *herself* as having moved around in front of the diagram in its new position, and guided herself by her memory picture of the chart. When a similar test was made with the six-syllable pack on observer M, she showed an average delay of one second in the rotated position, thus suggesting that the visual image was actually less effective for this more complex diagram. When observer W, on the other hand, was put through this test, the average delay in sorting the cards on the rotated diagram was, for the four-syllable pack, 6.9 seconds, and for the six-syllable pack, 11 seconds. This observer had great difficulty in sorting the cards on the rotated diagram, and constantly made false movements in accordance with the habit for the original position of the chart, while M made few or no such movements. The results were thus in accordance with what we should expect from the mental type of the observers.

In the second place, it seemed possible that a person who used much visual imagery in the card sorting would be more affected by distractions tending to suggest visual images, or indeed any mental images of whatever sense department, than one whose sorting was almost purely motor. Accordingly, four tests were made with each of the three observers, M, H, and W, in each of which the four-syllable pack was first sorted without distraction, and then, after a one-minute interval, sorted again on the same diagram while the experimenter read aloud. The observer was required to give from memory at the close of the experiment the substance of the passage read. Since the sorting under distraction was done on the same diagram as that without distraction, practice should have shortened the time occupied by it, and any lengthening would be in spite of practice. Observer W was not at all delayed by the reading aloud. The time of the sorting under distraction was on the average 2.2 seconds less than that of the sorting without distraction, and W's recollection of the substance of the reading was as good as that displayed by either of the other observers. Observer M, the most 'visual' of the trio, was delayed by the reading, on the average, 11.5 seconds, and observer H was delayed 10.5 seconds. As M sorted the cards in general more rapidly than the other two observers, her delay under distraction was, in proportion, much greater than that of H or W. The ratios of the average amount of delay under distraction to the average time of an undistracted sorting were as follows: for W, —.4; for H, .15; for M, 2.2. It will thus be seen that the most visual observer suffered most, and the most motor observer least, under distraction.

The first mentioned of these two special tests of the influence of mental type on card-sorting, that where the diagram is rotated ninety degrees, has been made use of to some extent in our laboratory as a method for determining type, and seems to promise well.